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The role of stress transactional theory on the development of fibromyalgia: A structural equation model

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Introduction. The aim of this paper is to evaluate the efficacy of a model based on the Lazarus & Folkman's transactional theory of stress to explain perceived stress and symptoms in a sample of people with fibromyalgia.

Methods. The design was an open, cross-sectional, uncontrolled study. Subjects were contacted through internet. A self-administered questionnaire was used that contained each of the variables included in the model. To perform the statistical analysis we used structural equation models.

Results. We evaluated 165 people who reported to have fibromyalgia diagnosis, 93.9% were female. According to PHQ-15 categories, used to measure symptoms, 83% of the participants were in the highest level of somatic symptom severity. FIQ was used to evaluate fibromyalgia impact, its maximum score is 100 points; taking into account mean and standard deviation, the samples are severely affected by fibromyalgia. We estimated five structural models; fifth model confirmed that some personal and social resources (self-esteem, self-efficacy, social support) perform as predictors of perceived stress level explaining 53% of its variance. This perceived stress was predictor of a latent variable indicated by symptoms and FIQ, and it explained 31% of its variance. Goodness of fit index was adequate.

Conclusions. The study suggests the important role that perceived stress has in the fibromyalgia impact and the symptoms severity. This model can help to adequate and establish targets for the psychological treatments included in multidisciplinary programs for this disorder.

Key words:
Fibromyalgia, stress, perceived stress

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El papel de la teoría transaccional del estrés en el desarrollo de la fibromialgia: un modelo de ecuaciones estructurales

Introducción. El propósito de este estudio es evaluar la eficacia de un modelo basado en la teoría transaccional del estrés de Lazarus y Folkman para explicar el estrés percibido y los síntomas en una muestra de personas con fibromialgia.

Metodología. El diseño fue transversal. Los sujetos fueron contactados a través de Internet. Se utilizó un cuestionario autoaplicado con las variables incluidas en el modelo. Para los análisis estadísticos se utilizaron modelos de ecuaciones estructurales.

Resultados. Se evaluaron 165 personas diagnosticadas de fibromialgia, el 93,9% eran mujeres. De acuerdo a las categorías del CSP-15, el 83% de los participantes tenían alto nivel de severidad en síntomas somáticos. El CIF se utilizó para medir el impacto de la fibromialgia, la puntuación máxima es de 100 puntos; teniendo en cuenta la media y desviación estándar de la muestra, los participantes estaban gravemente afectados por la fibromialgia. Se estimaron cinco modelos estructurales, el quinto confirmó que algunos recursos personales y sociales (autoestima, autoeficacia y apoyo social) eran predictores del estrés percibido, explicando el 53% de su varianza. El estrés percibido era predictor de una variable latente cuyos indicadores fueron los síntomas y el CIF, explicando el 31% de su varianza. Las estadísticas de bondad de ajuste fueron adecuadas.

Conclusiones. El estudio sugiere el importante papel del estrés percibido en el impacto de la fibromialgia y la severidad de los síntomas. Este modelo puede ayudar a adecuar y establecer objetivos para los tratamientos psicológicos incluidos en programas multidisciplinares que traten esta enfermedad.

Palabras clave:
Fibromialgia, estrés, estrés percibido

INTRODUCTION

Fibromyalgia is one of the most common and difficult to manage pain syndromes.¹ It is a chronic, debilitating, psychophysiologic disorder whose etiology remains unknown.² Fibromyalgia is likely to be a multifactorial condition in which a number of biological and psychosocial factors interact, including factors predisposing an individual to develop the condition and as factors tending to perpetuate it.²

Since early 90's, many papers have focused on the importance of stress on the development of fibromyalgia^{3,4} and this number has been increasing exponentially in the last decade.⁵ Many psychological topics such as parental bonding and alexithymia,⁶ sexual abuse at childhood,⁷ psychiatric comorbidity,⁸ catastrophization⁹ or coping¹⁰ seems to be crucial in the complex etiology of fibromyalgia. As an example, the most used classification of this syndrome described by Giesecke et al¹¹ is based on depression, catastrophization and pain. In addition, psychological factors are essential for the design of effective treatments for the patients with this syndrome.^{3,4}

Nevertheless, to our knowledge there are a small number of researches about explanatory models of fibromyalgia that take into consideration psychological theories such as Lazarus & Folkman's transactional theory of stress.¹² The Transactional Model of Stress defends that stressful experiences should be considered person-environment transactions, where the person's appraisal of the stressor and the social and cultural resources at his or her disposal will determinate the stress level.¹² Recently, a model based on this theory¹³ was able to explain psychosomatic symptoms in a population of university students. In this model, some personal and social resources (self-esteem, self-efficacy, social support) were predictors of perceived stress level, and this perceived stress in addition to emotional exhaustion

(burnout) were predictors of psychosomatic symptoms (Figure 1). Coping is an important variable in Lazarus & Folkman theory; nevertheless, in the research cited,¹³ using a multigroup structural equation modeling approach, significant structural differences were not present in the measurement of model constructs among lowest, middle, and upper use of each type of coping (emotional or rational). Based on that research, we selected the variables included in the current paper.

The empirical evidence about this model¹³ suggests that it could be applied to explain fibromyalgia from transactional theory. The objective of this paper is to evaluate the efficacy of a model¹³ based on the Lazarus & Folkman's transactional theory of stress to explain perceived stress and symptoms in a sample of people with fibromyalgia.

METHODS

Design: An open, cross-sectional, uncontrolled study.

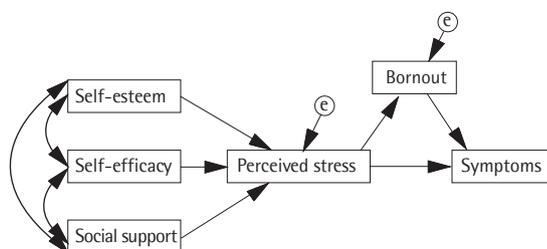
Subjects: Patients that fulfill the following inclusion criteria: 1.- To belong to a recognized National Association of Fibromyalgia. 2.- To accept to participate in the study. Exclusion criteria: 1.- Did not complete the survey. 2.- Did not have a confirmed diagnosis

Sample: According to accepted statistic criteria a sample between 100 and 200 subjects is considered adequate for studies involving parsimonious models to be estimated by structural equations.¹⁴

Procedures: Subjects were contacted through internet groups of people who were diagnosed with fibromyalgia and belonged to National Associations of Fibromyalgia. All of them accepted to answer the survey through internet. Subjects sent an email and asked for the survey that was designed in an excel file; after answering it, subjects back the survey to researchers. The patients were recruited from August 2007 to May 2008. This study is a part of a wide research on fibromyalgia¹⁰ and it has been approved by the Ethical Board of Aragon, Spain (CI PI08/30). Specifically the research reported in this paper was approved by Ethical Board of the Faculty which first and third authors belong.

Measurements: We used self-reported psychometric instruments. We used the same instruments employed in the original model study¹³ to measure self-esteem, self-efficacy, social support, perceived stress and symptoms; and we added other instruments to measure fibromyalgia impact and burnout. These were the instruments used:

- The *Rosenberg Self-Esteem Scale*¹⁵ is a 10-item self-report measure of global self-esteem. It consists of 10



Assessed basal model: it shows stress perceived is linked to three main variables, whereas burnout acts as a predictor of psychosomatic symptoms. Measurement errors associated with each observed variable are represented by "e".

Figure 1

Transactional model of stress: an explanatory model of psychosomatic symptoms¹³

items related to overall feelings of self-worth or self-acceptance. The items are answered on a four-point scale, ranging from strongly agree to strongly disagree. This is one of the most used questionnaires to measure self-esteem.¹⁶ Consistency as measured by Cronbach's alpha coefficient was 0.87 in the current research.

- The *Generalized Self-Efficacy Scale* is a 10-item psychometric scale that is designed to assess optimistic self-beliefs to cope with a variety of difficult demands in life, developed by Jerusalem and Schwarzer;¹⁷ this scale has been adapted to more than 10 languages, based on the German and English versions of the instrument. Consistency was 0.92 in the present study.
- *Duke-UNC functional social support questionnaire*¹⁸ is an 11-item self-assessment scale that records people's opinions on the availability of others capable of offering support in times of difficulty, with access to social relationships and to their own possibilities for empathic and emotional communication. The items are evaluated on a 5-point Likert type scale. In the present research Cronbach's alpha reached the value of 0.93.
- *Stress Perceived Scale (PSS)*,¹⁹ using Mexican adaptation²⁰ that has 14 items and is rated on a 5-point Likert type scale, ranging from 0 (never) to 4 (very frequently). Scores of negative items are reversed. Higher scores correspond to higher perceived stress. Consistency as measured by Cronbach's alpha coefficient was 0.91 in the current study.
- *Patient health questionnaire (PHQ-15)* is a somatic symptom subscale derived from the full PHQ.²¹ It includes 14 of the 15 most prevalent DSM-IV somatization disorder somatic symptoms. Thirteen of the PHQ-15 somatic symptoms ask to rate the severity of each symptom as 0 ("not bothered at all"), 1 ("bothered a little"), or 2 ("bothered a lot"). Two additional questions inquire about depressive symptoms in the last two weeks. Thus, in determining the PHQ-15 score, each individual symptom is coded as 0, 1, or 2, and the total score ranges from 0 to 30. The authors' scale proposed four categories of somatic symptom severity: minimal (PHQ-15 score 0-4), low (score 5-9), medium (score 10-14), and high (score 15-30).²¹ Consistency as measured by Cronbach's alpha coefficient was 0.77 in the current study; every item had a positive correlation with the scale.
- *Fibromyalgia Impact Questionnaire (FIQ)* is a 10-item self-report questionnaire that measures the health status of patients with fibromyalgia.²² The first item focuses on the patient's ability to perform physical activities. The following two items require the patient to indicate the number of days in the past week they felt good and how many days of work he or she missed. The remaining seven items concern the ability to work, pain, fatigue, morning tiredness, stiffness, anxiety, and depression and are measured with the visual analogue scale (VAS). In the present study we used a Spanish

version of the FIQ that has been translated and validated.²³ Higher score indicates a greater impact of the syndrome on the person. Each of the 10 items has a maximum possible score of 10. Thus the maximum possible score is 100; severely affected patients are usually 70 plus. In the present research Cronbach's alpha reached the value of 0.84.

- *Brief questionnaire of burnout (CBB, because its name in Spanish)*,²⁴ is a 21-item self-report questionnaire organized in three subscales: burnout syndrome (9 items), risk factor to burnout (9 items) and burnout consequences. It is rated on a 5-point Likert type scale, ranging from 1 to 5.²⁴ For the analysis we only used burnout syndrome subscale. Consistency as measured by Cronbach's alpha coefficient was 0.96 in the current study.

Statistical analysis: Structural equation models (SEM) were conducted using AMOS. These models permit to include variables that are correlated with, and can be used to predict one or more variables.

Parameter estimates, including factor loadings, path coefficients for direct, indirect and total associations, and residual error variance terms for criterion variables, were tested for statistical significance ($\alpha=.05$, two-tailed). The following criteria were used as indexes of acceptable model fit: 1.- Goodness of Fit (GFI) >0.90; 2.- Adjusted Goodness of Fit Index (AGFI) >0.90; 3.- Root Mean Square Error of Approximation (RMSEA) <.05; 4.- Comparative Fit Index (CFI) >0.90 and (5) $X^2/df < 3$.¹⁴

The analysis process started with a model defined from theoretical approach (Figure 1). Taking into account that Gonzalez Et Landero's model included the variable emotional exhaustion,¹³ we estimated a first model only with the 87 subjects who had a job. A second model with all 165 subjects was estimated; this model did not include burnout, neither fibromyalgia impact (FIQ), thus we estimated a third and a fourth models where symptoms and FIQ were a result of perceived stress; in the third model we evaluated effect of FIQ on symptoms and in the fourth model the effect of symptoms on FIQ. Finally, we estimated a fifth model with a latent variable indicated by symptoms and FIQ. Models two to five were estimated with 165 subjects.

RESULTS

The subjects were 165 people who reported to have fibromyalgia diagnosis. The sample, from which 93.9% were females, was distributed as follows: Mean age of the participants was 43.28 years (SD =9.28). Regarding civil status, 58.2% were married and 9.1% in cohabitation; 87 (52.6%) subjects had a formal job. Due to subjects were

Table 1	Central tendency measures			
	Median	Mean	Standard deviation	Score
Social support	35.0	34.6	12.11	11-55
Self-efficacy	28.0	27.6	6.62	10-40
Self-esteem	28.0	28.4	6.39	10-40
Perceived stress	31.0	30.3	9.91	0-56
Burnout*	23.0	23.0	7.65	9-45
Symptoms	19.0	18.7	4.79	0-30
FIQ	72.2	69.2	14.29	0-100

* Estimated with 87 subjects

recruited by internet, the sample was composed by people from different countries; mostly from Spain (45.5%) and Mexico (26.1%).

The central tendency measures of the variables included in the structural models are showed in table 1. According to PHQ-15 categories,²¹ 83% of the participants were in the highest level of somatic symptom severity; 13.9% in medium; 1.2% in low level and only 3 subjects (1.8%) were in the lowest level. FIQ maximum score is 100 points, taking into account mean and standard deviation; the samples are severely affected by fibromyalgia.

Structural equation models

A first model was estimated by the 87 subjects who had an active job. This model confirms partially the original model,¹³ explained variance for symptoms was 13%; the regression weight for burnout in the prediction of symptoms is not significantly different from zero ($\beta=0.18$; $p=0.096$); the other parameters were adequate ($p<0.05$). The non-

significant parameter could be indicative of a small sample size. Goodness of fit indexes was adequate (Table 2).

The next models were estimated by complete sample. In the second model burnout was excluded; perceived stress is directly associated with symptoms ($\beta=0.39$; $p<0.05$); explained variance for symptoms was 15%. Goodness of fit indexes was adequate (Table 2).

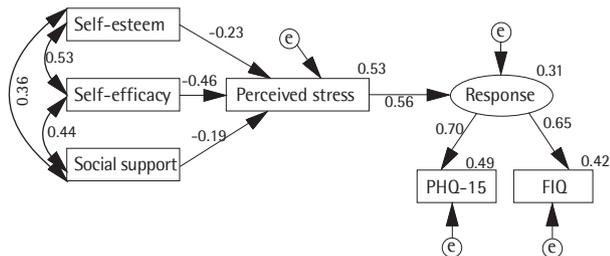
Third and fourth model evaluate respectively the effect of FIQ on symptoms ($\beta=0.36$); and of symptoms on FIQ symptoms ($\beta=0.37$), both of them are statistically significant ($p<0.05$). Perceived stress is directly associated with both variables.

Thus, we estimate the fifth model with a latent variable indicated by symptoms and FIQ (Figure 2). In fifth model, 53% variance of perceived stress is explained by self-esteem, self-efficacy and social support, all of them negatively associated with perceived stress. Perceived stress is positive associated with the latent variable (response) ($\beta=0.56$; $p<0.05$) and explain 31% of its variance. Goodness of fit of the models third to fifth was adequate. The indexes have the same values; the models have the same degree of freedom.

DISCUSSION

This is, to our knowledge, the first study assessing Lazarus & Folkman's transactional theory of stress¹² in fibromyalgia and also the first that uses structural equation models to understand the effect of psychological variables in this disorder. The results seem to support the role of stress and, specifically, of this model on the symptoms of the disorder. The main limitations of the study are the following: 1.- The sample was made up exclusively of people who said to have fibromyalgia diagnosis, but they have not been specifically diagnosed for this research. However, most National Associations of Fibromyalgia are quite stringent on the admission of new members and they require a diagnosis carried out by a rheumatologist. 2.- Sample size could be

Table 2	Goodness of fit						
	Models	χ^2	df	χ^2/df	GFI	AGFI	RMSEA
1	4.578; $p=0.599$	6	0.763	0.983	0.941	0.000	1.000
2	0.535; $p=0.911$	3	0.178	0.999	0.993	0.000	1.000
3	0.979; $p=0.986$	6	0.163	0.998	0.993	0.000	1.000
4	0.979; $p=0.986$	6	0.163	0.998	0.993	0.000	1.000
5	0.979; $p=0.986$	6	0.163	0.998	0.993	0.000	1.000



Final model assessed. Perceived stress is explained by self-esteem, self-efficacy and social support; their negative relationship with stress is shown in the model. Perceived stress is positively associated with the latent variable (response) indicated by somatic symptoms (PHQ) and fibromyalgia impact (FIQ). Variance explained percentages are represented in bold. Measurement errors associated with each variable are represented by "e".

Figure 2

Fifth model, standardized solution

considered a bit limited. 3.- Cross-sectional design is not the ideal design to test causal-effect relationships; nevertheless, the time required by, and the high cost of a longitudinal study, make it difficult to perform. Regression and structural equation models provide options to cross-sectional studies with objectives like ours.

Comparing our results with those found in the original description of the model in students,¹³ using Student's T test, without assuming that the groups variance are equal (Levene's test was significant); fibromyalgia sample, as was expected, shows more stress ($M=30.3$; $SD=9.91$ vs. $M=21.9$; $SD=7.03$; $t(241.5)=9.768$, $p=.001$); more symptoms ($M=18.7$; $SD=4.79$ vs. $M=6.8$; $SD=4.07$; $t(27.8)=27.810$, $p=.001$), less social support ($M=34.6$; $SD=12.1$ vs. $M=46.2$; $SD=8.18$; $t(234.2)=-11.160$, $p=.001$), less self-esteem ($M=28.4$; $SD=6.39$ vs. $M=35.0$; $SD=4.37$; $t(235.9)=-12.141$, $p=.001$) and less self-efficacy ($M=27.6$; $SD=6.62$ vs. $M=32.7$; $SD=4.82$; $t(245.7)=-8.978$, $p=.001$) than students. Compare our results with these, permits a better description about our sample and our results.

The basal model (Figure 1) assessed consider that stress perceived by the patient is linked to three main variables (self-esteem, self-efficacy and social support). In fact, the results of the five models evaluated confirmed it. One of these three variables: self-efficacy, has been identified as a factor that influences disability and pain intensity in fibromyalgia.²⁵ However, the second part of the model based on transactional theory of stress (i.e.: perceived stress in addition to emotional exhaustion (burnout) were predictors of psychosomatic symptoms), was not confirmed. In this sample, burnout was non-significantly different from zero in the first model that assessed burnout only in working people. However, estimating a second model, without burnout and with the complete sample, the explained variance of symptoms improved. Based on these results,

despite some authors have linked job stress/burnout to fibromyalgia,²⁶ we consider burnout could be a minor variable in the explanatory model of symptoms in patients with fibromyalgia, at least in our sample. Obviously, the small sample size could be an alternative explanation.

Based on some of the previous models, we developed a final hypothesis. Third and fourth models suggested that symptoms and fibromyalgia impact could be considered as one only variable in the structural model. In addition, fibromyalgia impact was measured by FIQ, and this questionnaire evaluates the consequences of symptoms. For this reason, we considered both measurements (PHQ and FIQ) as stress responses. Therefore, in the fifth and last model it was included a latent variable indicated by them. This model showed an adequate fit.

It has been documented that patients with fibromyalgia report more life events than general population.⁴ In fact, we found that mean stress score ($M=30.3$; $SD=9.91$) in our sample is higher than the score reported in other samples assessed under the same scale (PSS), such as students ($M=21.9$, $SD=7.03$),¹³ patients with HIV ($M=22.57$, $SD=8.67$),²⁷ and people with other chronic diseases ($M=25.0$, $SD=8.1$).²⁸ Stress can induce symptoms such as pain via nonimmunological mechanisms;²⁹ as a consequence, more studies about the role of stress in fibromyalgia are necessary.

Finally, our model mainly considers positive variables (self-esteem, social support, self-efficacy), in consequence future studies should include mental disorders, as predictors of somatic symptoms. Previous studies have shown that mental disorders such as depression are common in patients with fibromyalgia as well as the combined effect that these conditions have on the quality of life of these patients.³⁰ Consequently, including these variables in the structural model could improve the explanation about somatic symptoms and fibromyalgia impact.

In addition, we recommend to future research to consider the classification of Giesecke of fibromyalgia into three subgroups¹¹ and to evaluate the model in each of them. There are a series of specific pharmacological and psychological-type recommendations for each of the subgroups and that make possible to have a personalized approach to the patient with fibromyalgia in accordance with their individual clinical characteristics; for that reason, it could be possible to detect differences in our structural model among three subgroups.³¹

CONCLUSIONS

Our study, summarized in figure 2, confirms the importance of Lazarus & Folkman's transactional theory of

stress, and suggests the important role that perceived stress play in the fibromyalgia impact and the symptoms severity. This model can help to adequate and establish targets for the psychological treatments included in multidisciplinary treatment programs for this disorder.

COMPETING INTERESTS

The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS

MTGR is the principal researcher and developed the original idea for the study. RLH and JGC participated in the design of the study, RLH and MTGR conducted the study and performed data analyses. MTGR and JGC drafted the manuscript. All authors have read and corrected draft versions and approved the final version.

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